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"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH

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ZOOLOGICAL REPORTS OF THE VOYAGE OF H.M.S. "CHALLENGER"

Report on the Scientific Results of the Voyage of H.M.S. "Challenger" during the Years 1873-76, *under the Command of Capt. George S. Nares and Capt. F. T. Thomson.* Prepared under the Superintendence of the late Sir C. Wyville Thomson, Director of the Civilian Scientific Staff on board, and now of John Murray, one of the Naturalists of the Expedition. Zoology—Vol. V., 1882; Vol. VI., 1882; Vol. VII., 1883. (Published by Order of Her Majesty's Government.)

THE editor has made most excellent progress in the work of publishing the Reports of the scientific results of the voyage of H.M.S. *Challenger* during the past year, as the three bulky quarto volumes now before us well indicate. Vol. V. contains an elaborate Report on the Ophiuroidea by Theodore Lyman, who has made this group so long his special study, and who has in this monograph given us a most elaborate and beautifully illustrated contribution to science. The memoir contains the description of some twenty-one genera and of 170 species, but as several already described species were also collected, Mr. Lyman has judiciously given not only all these but also the names of all others previously described, arranged under their genera, constituting therefore this Report a more or less complete monograph of the Ophiuroidea. There are very elaborate tables of distribution, geographical, bathymetrical, and thermal, with brief remarks on their indications, and at the end of these is a note on the fossil forms and their relations to those living. In the descriptive part of the monograph Mr. Lyman has ventured to use simple words as often as possible, so as not to add to "the jargon in which zoology is now smothering."

Amid the three hundred pages of description of species there is of necessity little that will bear transcribing in a general notice of this important work; and still among them we find the following, which in the writer's mind awakened similar emotions to those referred to by Mr. Lyman:—"In my notebook of 1861 I find, '*Euryale exiguum*, Lamk., original of Peron and Leseur, 1803, young.' This prosaic line is poetical to me. It takes me back to the Jardin des Plantes as it was twenty years ago, and I can see the laboratories of the 'mollusques et zoophytes' where I studied under the kindly direction of old Valenciennes. He has gone, and so has his successor Deshayes, and their place is now worthily held by Perrier, who was a very young man when first I knew him. But still that poor little broken *Astrophyton exiguum* lies on its shelf, the survivor. It was with a real emotion that in unpacking the *Challenger* collection I drew from a large jar two fine specimens. I felt like a scholar who had found a duplicate of the Codex argenteus. After more than two generations the unique treasure of the Jardin des Plantes has at last other representatives, and to celebrate its rediscovery I could do no less than give a figure of the animal" (Plate 47).

So far as the geographical distribution of the group is concerned, it would appear that although deep-sea species are more inclined to extensive wanderings than those frequenting shallows, yet, speaking generally, they offer similar differences. Among littoral forms there are those which are found all over the great ocean from the Sandwich Islands to the east coast of Africa, and even south to the Cape of Good Hope. One species, *Amphiura squamata*, is found in the North and South Atlantic, at the Cape of Good Hope, and in Australia. Others, again, are considerably restricted; for example, the abundant fauna of the Carribean Sea, which reaches only Brazil on the south and the Carolinas on the north. *Ophiacantha vivipara* and *Gorgonocephalus pourtalesii* going to 14c and 600 fathoms, are remarkable for their extension in longitude, being found from the Kerguelen Islands on the west to the east coast of South America. As to the very deep-water species, *Ophiomusium lymani* occurs well up in the North Atlantic, in the extreme South Atlantic, near New Zealand, off Japan, and off the south-west coast of South America. *Ophiacantha cosmica* is found off the Brazil coast, between the Cape of Good Hope and the Kerguelen Islands, off the south-west coast of South America, and at intermediate points. Some of these deep-sea species are, however, quite restricted in their area, such as *Pectinura heros*, *Ophiomusium validum*, and *Astroschema arenosum*, the first living near the Celebes, the last two in the Carribean Sea. While species differ thus much in the extent of their migrations, there are certain bottoms where they seem to decline to live at all. Thus in all the deep water from the centre of the North Pacific to near the south-west coast of South America, there was not a single Ophiuran found. As to their distribution in depth, a very large proportion live exclusively on the littoral zone, and therein are included species both of cold and of hot water, though the number of the latter is much the larger. Some fifty species live exclusively below 1000 fathoms, and have to endure a degree of cold near to freezing, an enormous water pressure, and an entire absence of sunlight.

The forty-eight, rather crowded, plates have been drawn with skill and fidelity by Miss K. Pierson and Mr. L. Trouvelot with the exception of Plate 48, which represents half of an arm of *Gorgonocephalus verrucosus*, carried out to its extreme twigs, and which stands as quite a monument of patience on the part of Mr. Lyman's assistant, Miss Clark.

The Second Report in this volume is by Prof. D. J. Cunningham, on some points in the anatomy of *Thylacinus cynocephalus*, *Phalangista maculata*, and *Phascogale calura*, with an account of the comparative anatomy of the intrinsic muscles and the nerves of the mammalian pes. This Report gives details of the anatomy of three little known mammals, representing types which differ widely from each other both in physique and habits. A special interest attaches to the anatomy of the Thylacine, as it is rapidly becoming extirpated. In examining the intrinsic muscles of the marsupial manus and pes, Prof. Cunningham encountered a somewhat puzzling multiplication of the elements. To clear this up and at the same time to connect the condition with that found in other animals he was induced to extend his inquiries upon this point into mammals in general, and we are therefore favoured with the results of this comparative research in a very elaborate report on the comparative anatomy of the mammalian foot.

Vol. VI. contains also two memoirs: the first is a Report on the Actiniaria, by Prof. Richard Hertwig. As a considerable number of specimens did not reach Königsberg until this Report was finished, we are promised a supplementary report to describe these additional forms. Fourteen plates accompany this Report. Beginning with a detailed description of a typical Actinian, we have also a comparative survey of the chief characteristics of the several divisions and genera. Six tribes of Actiniana are distinguished: (1) Hexactiniæ; (2) Paractiniæ; (3) Monauleæ; (4) Edwardsiæ; (5) Zoantheæ; (6) Ceriantheæ. Objecting to Verrill's assertion that all specimens of Actiniæ which are only known from preserved specimens should be thrown away as of no scientific value, Prof. Hertwig has laboured manfully over the unfortunately rather badly preserved specimens of the *Challenger* voyage; and by keeping in view such factors in their description as the structure of the tentacles, of the septa, of the oral disk, of the circular muscle, &c., he has presented a most minute and elaborate description of an immense variety of new forms, the scientific value of which will go without dispute. As the collections of the *Challenger* were for the most part made in the open oceans, the littoral zone, which would have furnished the larger proportion of Actiniæ was almost entirely neglected, and but one littoral species occurs in the list. As a rule the number of the Actiniæ decreases as the depth increases; they have not been observed at a depth of over 2900 fathoms, but the greater the depth the more the fauna was found to vary from that of the coast. Of the twenty-one forms from 500 to 3000 fathoms described, no less than six species are found to have undergone some extreme modifications of their tentacles, whilst a like phenomenon has never been observed in a single one of the forms of the coast fauna, which greatly exceed the deep-sea fauna in number. These alterations lie for the most part in the direction of transforming the tentacles into tubes and openings, and Prof. Hertwig connects this with the nutriment of these deep-sea forms, which is not of a nature to be captured by tentacles.

The Second Report is on the Tunicata, by Prof. Herdman. It is Part I., on the Simple Forms. The collection generally was found to be in a state of excellent preservation, and consisted of eighty-two species, which are referred to twenty genera. Of these, seventy-four of the species and nine of the genera are new to science, but it has not been found necessary to form any new families. The new genera are mostly instituted for very deep-sea species. In several instances the new genera have been of great interest, as they have demonstrated affinities between known forms, and have exhibited combinations of characters which in some instances necessitated a revision of the definitions of old genera, and even affected one's ideas with regard to the characters of the families. The new species are all beautifully illustrated in thirty-seven plates. The memoir has prefixed to it a history and bibliography of the group and a neat and well-written account of its anatomy, which is accompanied by an excellent series of woodcuts. So little is known as to the geographical distribution of the group that Prof. Herdman thinks any generalisation on this head would be of little value. A few facts of interest are, however, mentioned: thus the Tunicata are greatly more numerous in the southern than in the northern hemisphere, and they reach a maximum of abundance in the far south. As to their distribution in depth, the four families are found to have the following limits:—

The Molgulidæ range from	the shore to	600	fathoms.
The Cynthiidæ ,,	,,	2600	,,
The Ascidiidæ ,,	,,	2600	,,
The Clavelinidæ ,,	,,	129	,,

Seven species were found at depths of from 2000 to 3000 fathoms.

Calcareous spicules are noticed as present in the tests of several species of the genera Culeolus and Cynthia. They are very different in the two genera, being irregularly branched and with smooth surfaces in Culeolus, while they are rod-shaped or fusiform, with their surfaces minutely echinulated in Cynthia. Neither of the two previously known genera in which the test is remarkably modified—Rhodosoma and Chelyosoma—were collected during the *Challenger* Expedition, but two of the new forms show notable peculiarities in the test, Pachychlœna having it greatly thickened all over, while *Hypobythius calycodes*, Moseley, has a series of symmetrically placed nodular cartilaginous thickenings in the otherwise thin and membranous test. This Report of Prof. Herdman's may be regarded as almost a monograph of the Tunicates, and is a most valuable addition to our knowledge of this little known group of forms.

Volume VII. contains four Reports. The first of these is by Prof. Morrison Watson, on the anatomy of the Spheniscidæ collected during the voyage. The collection contained three or four adult specimens of each of the species obtained, preserved for the most part in brine, but in some instances in spirit, as well as a number of immature birds taken from the nest, together with eggs in various stages of hatching, preserved partly in spirits and partly in bichromate of potash. In the present Report only the anatomy of the adult birds is treated of; that of the young being reserved for a second part. Selecting *Eudyptes chrysocome* from Tristan d'Acunha as a standard, the anatomy of the other seven species is compared with it; thus in every section the anatomy of the standard species is given in detail, and then the variations met with in each of the others is appended. In those cases in which no variations are reported the anatomy of the forms was identical. The descriptive anatomy of the various systems of tissues seems to leave little to future investigators to record. In the section devoted to osteology, while treating of the bones of the anterior extremity, the author remarks that in several particulars the penguin's wing differs from that of other birds—movements of pure flexion and extension in the joints beyond the shoulder can scarcely be said to be possible; the articulations, however, admit of a very considerable amount of rotation, and consequently, instead of the limb being converted into an absolutely rigid paddle or oar, the rotation in question converts the wing into a screw-like blade, the curvatures of which are constantly varying in accordance with the amount of rotation which the forms of the different joints permit. Upon carefully watching a living specimen of Aptenodytes in the Zoological Society's Gardens, the author observed that the wing of the penguin is never used in the manner of a rigid oar, which would imply the simultaneous movement of both wings in the same direction in order to propel the bird. On the contrary, the wings were often and indeed usually brought into use alternately, much in the same manner as the pectoral fins of a fish, and in every movement of the wing wiry, screw-like curvatures, which are due to the rotation of the different segments of the limbs upon one another, are strongly developed. In fact, a constant screwing and unscrewing of the separate alar segments upon one another takes place simultaneously with the forward and backward movement of the organ as a whole.

From general considerations of the anatomy of the penguin, Prof. Watson concludes that these birds together form a natural group, every member of which is possessed of certain anatomical peculiarities which serve at once to associate it with its fellows and to separate it from the members of other groups which may more or less closely resemble the Spheniscidæ. From an anatomical point of view he would recognise but three genera—Aptenodytes, Spheniscus, and Eudyptes. The remarks on the characteristics of these genera and the limits of the species contained in them are among the most interesting in this Report.

As to the phylogeny of the penguins the author concludes that they form the surviving members of a group which had early diverged from the primitive avian stem, but that at the time when the separation took place, the members of that stem had so far diverged from the primitive ornithoscelidan form as to be possessed of anterior extremities, which, instead of forming organs of terrestrial, had become transformed into organs adapted to aërial progression, or true wings. If this view be correct, palæontological research may, in the course of time, disclose the existence of Spheniscidine remains which may enable us to trace the line of descent of the penguins of the present day from the original avian stem, and through it the relationship which exists between the modern Spheniscus or Eudyptes, with their separate metatarsal bones and aborted wings on the one hand, and the majority of modern birds, with their conjoined metatarsal bones and perfect wings on the other.

The geographical distribution of these birds is of great interest. They are entirely confined to the southern hemisphere, none of them straying north of the equator. Within this area their distribution is very extensive, reaching from the Galapagos Islands on the equator, southwards to the Antarctic Islands. Prof. Watson surmises that this distribution does not depend on temperature, but may depend on a relative abundance of the food supply (Cephalopods and Crustacea) found in the two hemispheres respectively; but the editor, Mr. J. Murray, in a footnote, says: "The penguins reach the equator only on the coasts of Chili and Peru. Now the Peruvian current from the Antarctic skirts along this coast, and takes a low temperature as far north as the Galapagos Isles; the temperature of the sea being there (equator) 62° to 66°, while in the middle of the Pacific (equator) the surface temperature is 81° to 88°. Temperature, therefore, most probably has something to do with the limitation of the geographical distribution of the Spheniscidæ."

The second memoir is by Dr. F. Buchanan White, on the Pelagic Hemiptera collected during the voyage. These, the only truly pelagic insects, belong to the genera Halobates and Halobatodes. The first of these was founded sixty years ago by Eschscholtz for three species taken during the well-known voyage of Kotzebue round the world. But few species are known, and they are very rarely to be found in collections, though they seem to be abundantly distributed in tropical seas. Their structure would seem to indicate that they are archaic forms of great antiquity, and as doubtless many species yet remain to be discovered, it is to be hoped that some one with the will and the opportunity will be found to turn their attention to the group. In the meanwhile Dr. White has in this Report given a detailed account of the literature of these genera, followed by an account of the anatomy and description of the genera and species. Of the genus Halobates he describes eleven species, of which three were first described by Eschscholtz, one each by Templeton and Frauenfeld, and six for the first time in this memoir. In his remarks on the species we notice that, after a very bad fashion adopted by some entomologists, these are alluded to under their trivial names only, thus: "according to Frauenfeld, *micans* differs from *willerstorfii*." This is the only departure from the ordinary rules of nomenclature that we have as yet noticed in these Reports, and we call attention to it in the earnest hope that it will not occur again.

Species of Halobates are recorded in Mr. Murray's journal as found twenty-one times in the Atlantic between latitudes 35° N. and 20° S., and thirty-eight times in the Pacific between latitudes 37° N. and 23° S. The majority of the specimens taken by the tow net were dead when brought on board, but some were taken alive and were observed skimming over the surface of the water in the glass globes. On one occasion a species was seen to dive. Of the species of Halobates now known, five occur in the Atlantic, but one only is restricted to that ocean, though the headquarters of another appear to be there. Six species, of which two are peculiar, occur in the Indian Ocean west of long. 100° E., while to the east of this, and chiefly in the West Pacific, eight species occur, of which four are restricted to that region. But taking the West Pacific and Indian Ocean together, we find that nine out of the eleven known species occur there, and five nowhere else. Of Halobatodes *H. lituralus* occurs in the Chinese Sea, *H. compar* is from India, *H. stali* from Ceylon. All the species are figured on three plates.

The Third Report is by Prof. Allman, on the Hydrozoa. Part I. Plumularidæ. Of the Hydroids, a large number of exotic species have been recently described, notably the collections made during the exploration of the Gulf Stream, and during the expedition of H.M.S. *Porcupine*, by Dr. Allman himself. But to this number the collection brought home by the *Challenger* makes a large and valuable addition. Of this collection the family of the Plumularidæ forms a considerable proportion. Only one form can be identified with a species occurring in the European seas. This species, *Cladocarpus formosus*, was dredged by the *Porcupine* from the seas lying to the north of Scotland, and by the *Challenger* from the seas at Japan. It is a well-marked species, and the great distance between the Atlantic and Pacific stations, without any intermediate station having been discovered, is a remarkable and significant fact. By far the larger number of the forms brought home by the *Challenger* consist of species new to science, while among these a considerable number have had to be assigned to new genera. Many of the species are of great interest from the light they throw on the external morphology of the group, and from the aid which they afford towards a philosophical conception of the significance of parts otherwise enigmatical. The Report is prefaced by some introductory remarks on the general morphology of the Plumularidæ. While not yet possessing the data necessary for a complete exposition of the geographical distribution of this group, it may be generally asserted that it attains its greatest development in the warmer seas of both hemispheres, and that in tropical and subtropical regions it has its maximum in multiplicity of form, in the size of the colonies and in individual profusion. The dredgings of the *Challenger* and of the United States Exploration of the Gulf Stream would further seem to point to two centres of maximum development within the area thus indicated—an eastern centre, which is situated in the warm seas around the Philippines and other islands of the East Indian Archipelago, and a western centre, which will be found in those which lie around the West Indian Islands and bathe the eastern shores of Central and Equinoctial America. In bathymetrical distribution the Plumularidæ present considerable variation. Among the species described some are quite littoral, having been dredged from depths ranging from between 8 and 20 fathoms. The greater number, however, have been obtained from depths between 20 and 150 fathoms, while three species, *Aglaophenia filicula*, *A. acacia*, and *Polyplumaria pumila*, are from a depth of 450 fathoms. The striking and beautiful genus Cladocarpus consists of eminently deep-water forms, and of the two species described, one—*C. formosus*—was obtained in the Japan seas from a depth varying between 420 and 775 fathoms; the same species from the north of Scotland was found at depths of from 167 to 632 fathoms. The second species—*C. pectiniferus*—was dredged off the Azores from 900 fathoms, being the greatest depth from which any Plumularidan is known to have been obtained. This Report is illustrated by twenty plates.

The last Report in this volume is on the genus Orbitolites, by Dr. W. B. Carpenter, with eight beautiful plates by Mr. George West, jun. Some thirty-six years ago Dr. W. B. Carpenter received from Prof. Edward Forbes some small discoidal bodies which had been dredged between 1842 and 1846 by Prof. J. Beete Jukes on the coast of Australia, with the hint that these were probably the Marginopora of Quoy and Gaimard. From this time to the present Dr. Carpenter has made a pretty constant study of these interesting Foraminifers, and he gives us a highly instructive account of the views held from 1823 by the various authors who have written on the genus, from the strange misconceptions of Ehrenberg to the accurate descriptions of Prof. Williamson, who first clearly determined the close affinity between Orbitolites and Orbiculina, thus disposing of the Bryozoic doctrine of Ehrenberg, and relegating these organisms to the Foraminifera. As the final result of Dr. Carpenter's laborious researches on this group, he concludes that while the ordinary notions of species will not apply to it any more than it will to any of the Foraminifera, still particular types of form are transmitted with marked genetic continuity, and he distinguishes four very well marked types of Orbitolites, around which the entire assemblage of specimens collected over a very wide geographical area, and from a great bathymetrical range, can be grouped without difficulty. Treating of the subject of descent, the author declares that "it seems to him that the evolution of this type from the simplest monothalamous Milioline has taken place according to a definite plan, of which we have the evidence in the wonderful uniformity and regularity of the entire sequence of developmental changes, whilst we are entirely unable to account for those changes without attributing to the subjects of them a capability of being affected by external agencies or modes so peculiar as to indicate a previous adaptation."

From an editorial note prefixed to this volume we learn that the various large incidental collections of terrestrial forms, such as insects, spiders, reptiles, &c., will not have any detailed reports published concerning them, but that they will be referred to in the narrative of the cruise, the first volume of which is announced for 1884.